The results of the research in this area are the scientific basis for solving the problems of increasing the efficiency of separation processes, searching for new methods for separating and fine-tuning substances, determining the optimal conditions for their conduct, taking into account the requirements of ecology and safety.

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PROFILING OF NUCLEAR POWER PLANTS

Oddi Cristofer Addo
National Research Tomsk Polytechnic University,
Russia, Tomsk, Lenin Avenue, 30, 634050

Nuclear Power Plants (NPP) comprises of components working together to generate heat energy for different applications including generation of electricity, production of radioactive isotopes and heating of homes. Studies are constantly done to improve reactor performance through better utilization and longer fuel cycle length. There are several factors which affect the performance of the reactor core including fuel enrichment, use of burnable absorbers, height of insertion of control rods and moderator design. These factors affect reactivity in different ways and proportions. For example, to maintain uniform power distribution at different levels of the reactor core, fuel of lower degrees of enrichment is used at regions of higher neutron flux while fuel with higher degrees of enrichment is used in regions of lower neutron flux. Therefore, to operate the reactor in safety standards, these factors should be profiled to ensure constant power and flux within the reactor. The study of the profiles of NPP will enable scientists and engineers develop and design standard and accurate components of nuclear power system.

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MEDICAL APPLICATIONS OF ACCELERATORS FOR RADIOLOGICAL STERILIZATION

L.V. Chernov
Scientific Supervisor: Prof., Dr. Yu.Yu. Kryuchkov
Linguistic advisor: O. P. Kabrysheva
National Research Tomsk Polytechnic University,
Russia, Tomsk, Lenin avenue 30, 634050
E-mail: lvc2@tpu.ru

Introduction. Accelerators of electrons are very popular nowadays due to the latest achievements of nuclear technology in medicine. They are used as sources of ionizing radiation, as diagnostic equipment, in radiosurgery and in different modifications of X-ray equipment almost in all countries of the world [1].

Radiological sterilization of medical items is one of the biggest industrial processes using ionizing radiation. At present more than 50% of single-use medical items are sterilized particularly by this one [2].

Ionizing radiation is a multi-purpose adverse factor for different kinds of bacterial flora, such as fungus, bacteria, spore and virus [3].

The aim of this work is to study practical applications of electron beam accelerators in medicine for sterilization.

Materials. It is possible to use high-current pulse-repetitive an electron beam accelerator from the "SINUS" family for radiological sterilization. Pulse frequency varies from the very few hertz to hundreds hertz. The energy of single particles in the electron beam, which goes through the aluminum foil, varies from 200 to 250 keV; pulse duration is 10 ns. Direct electron ionization influences bacterial flora at the depth from 0,1 to 0,2 mm. Long-lived secondary radicals also influence this flora.

A high current electron-beam accelerator is used as a sterilizer in this work (Figure 1). It was constructed in the Institute of High Current Electronics SB RAS (Tomsk).

Fig. 1. High current electron-beam accelerator

Sterilized material cannot be heated more than by 10°C in this way. It means that the high current electron-beam accelerator can sterilize thermolabile materials. Moreover, it is possible to create effective local biological lead protection on account of low energy of the particles. It provides safety of the staff and reduces the cost of workplace protection against radiation.

The following parameters guarantee sterilization of the absorbing nanostructured graphite-based wound dressing at 25 pulses per one item (Table 1) [4].

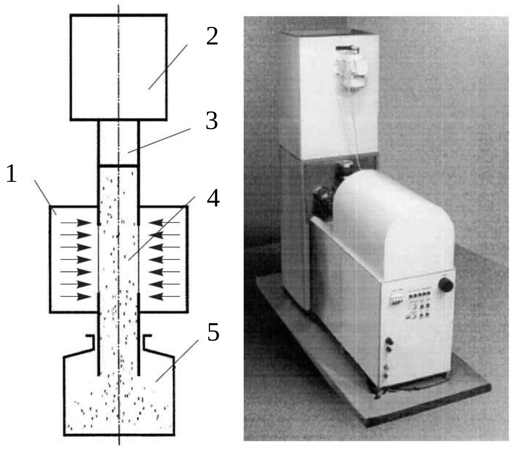
Table 1 Conditions of radiological sterilization of the wound dressing

Frequency of the accelerator	2 Hz
Maximum energy	230 keV
Maximum pulsing current of an electron-beam	4,5 kA
Effective pulse time	6 ns
Cross-sectional area of a visible electron-beam	0,015 m^2
Radiant exposure on surface of wound dressing per pulse (the distance between a wound dressing and a source hall is 15 mm)	400 J/m^2
Sterilization time of one wound dressing	12,5 s

Radiological sterilization can be also used for medicinal powders. These powders are not able to be sterilized by temperature because of thermolability. Also chemical sterilization is not possible, on account of accumulation of toxins in medicinal powders. The advantage of the sterilization is the sterilizing doses (25-50 kGy) which do not influence physical and chemical features in the ionized materials no matter which is used.

Sterilization of the whole amount of medicinal powders by low-energy electrons is performed at the facility of the Institute of High Current Electronics SB RAS (Figure 2). In this facility powder is poured perpendicular to an electron beam. In this process low-energy electrons penetrate irradiating powder evenly.

Nanosecond pulsing frequency low-energy electron accelerator "SINUS" is a source of electrons. For sterilization of the medicinal powders the following conditions are required (Table 2) [3].



a *b*

Figure. 2. Scheme of the facility (a) and a general view (b), 1 – accelerator, 2 – bunker with initial powder, 3 – dosage device, 4 – area of irradiation, 5 – bunker with bacteria-free powder

Table 2. Conditions of radiological sterilization of the medicinal powders

Density of the powder material	0,5 g/cm^3
Particle size	20-55 μm
Width of a channel (powder is aerated to the density of 0,05 g/cm^3)	30-50 mm
Energy of electrons	200-300 keV
Pulses frequency	50 Hz
Network electrical power (220 V)	3 kW
Average power of the electron beam	0,5 kW

Conclusion. As a result of this work, the method of radiological sterilization with an electron beam accelerator was studied. In the course of the present work a literature review has been carried out. It was shown that it is possible to use an electron beam accelerator for radiological sterilization of medical items and powders.

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APPLICATION OF AN ELECTRICAL DISCHARGE IN SALINE FOR REMOVAL OF BENIGN TUMORS

Z.K.Serikbekova

National Research Polytechnic University,

Tomsk, Russia, Lenin Avenue, 30, 634050

e-mail: zarina_lg5@mail.ru

Surgical instruments using plasma are widely used in various surgical procedures. The advantages of high-frequency plasma instruments are simultaneous hemostasis and dissection of tissues, and the ability to coagulate large vessels. A positive effect in this case is achieved by heat generation in the tissues. However, the temperature reaches 500 ° C and tissue is damaged to a depth of 5 mm [1]. The alternative method, which has recently begun to enter into medical practice is the removal of tissue using cold plasma. This method was developed by ArthroCare Co and named coblation [2].

Physical and chemical processes occurring in the plasma formed in a liquid are important for the understanding of the phenomena observed in surgical instruments. As the working fluid saline is used, which is prepared from sodium salt dissolved in water with a concentration of 0.9 g / l. The current passing through the electrolyte produces heat, which leads to the formation of a thin layer of bubbles, which covers the electrode. When an electrical discharge is created, gas in bubbles ionized.

Investigation of the device characteristics was conducted in saline solution. The output pulse of the device is biphasic with varying amplitude. The pulse repetition rate is f = 25 kHz. The current is measured via a shunt (RI = 1.5 ohms). The voltage and current were recorded by a digital oscilloscope. The voltage was varied between 50 – 300 V. When voltage is applied, the current value is determined by the conductivity of the electrolyte. As electrolyte is heating, gas bubbles near the electrode are formed. As a result, the current value is determined by the characteristics of the discharge.

The device is developed for biological tissue removing. The tests show that the resistance of the gap between the electrodes in the electrolyte increases with the applied voltage. Upon reaching a voltage ~180 V, its resistance rises sharply due to the formation of gas bubbles. Then therein a discharge is developed and a plasma is formed.

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NICKEL ISOTOPE SEPARATION OCCURING FILLING OF GAS CENTRIFUGE CASCADE WITH DIFFERENT STAGE NUMBER

A.A. Ushakov[1,2], A.A. Orlov[2], V.P. Sovach[1]

[1] JSC “PA ECP”, 663690, Zelenogorsk, Russia

E-mail: ushakovaa2015@sibmail.com